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Interpersonal Aggression among Aka Hunter-Gatherers of the Central African Republic

Assessing the Effects of Sex, Strength, and Anger

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Abstract Sex differences in physical and indirect aggression have been found in many societies but, to our knowledge, have not been studied in a population of hunter-gatherers. Among Aka foragers of the Central African Republic we tested whether males physically aggressed more than females, and whether females indirectly aggressed more than males, as has been seen in other societies. We also tested predictions of an evolutionary theory of physical strength, anger, and physical aggression. We found a large male bias in physical aggression. Controlling for anger, we found an adult female bias in indirect aggression. Physical strength predicted anger, which predicted hitting, although results were sensitive to the inclusion or exclusion of traditional healers, who were physically and emotionally distinct from other Aka. With some important caveats, our results generally support the predicted sex differences in physical aggression and indirect aggression, and the predicted relationships among anger, strength, and aggression.

Keywords Physical aggression · Indirect aggression · Social norms · Sex differences · Foragers

A male bias in physical aggression (i.e., a greater rate of physical aggression by males than females) is consistently seen in the relatively few cultures in which it has been systematically studied. Archer's 2004 meta-analysis of sex differences in

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aggression summarized results from more than 300 studies. This meta-analysis included self-report studies in thirteen 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 nine nations, with the male bias ranging from 0.34 in Belize to 1.97 in Kalmyk; and peer-report studies 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.

In contrast, nonphysical forms of physical aggression, such as gossiping and ostracism, often exhibit a female bias. These types of aggression have been given different names, including indirect aggression, relational aggression, and social aggression; in accordance with Archer and Coyne (2005) we refer to them as *indirect aggression.* The empirical evidence for a universal female bias in indirect aggression is weak, however, 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 the fact that studies in different nations involved different indirect aggression scales and different ages. Across age categories, the largest female bias occurs in teenagers.

There are many theories of sex differences in aggression. The "social learning" accounts of sex differences in aggression have been particularly influential (e.g., Bandura 1973; Eagly and Wood 1999), positing that sex differences in aggression can be largely explained by sex differences in learned behavior. The theories differ on what, exactly, is learned (behaviors, norms, roles, attitudes, perceptual biases, response biases, scripts or programs for behavior, levels of internalization of gender stereotypes, etc.), and on how it is learned (e.g., experience vs. imitation), but many attribute sex differences in aggression to sex differences in norms regulating aggression. In addition, social learning models of aggression suggest that within-sex differences in aggression can be attributed to within-sex differences in social learning (for discussion of social learning theories of aggression, see Archer 2009; Barry et al. 1976; Campbell et al. 1996).

Evolutionary theoretical accounts of sex differences in aggression, on the other hand, argue that sexual selection explains variation in aggression across and within the sexes. Regarding between-sex variation, 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 females are expected to contest over access to food and other limiting resources, whereas human males are expected to contest over sexual access to females, frequently employing costly forms of physical aggression because 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). In addition, human males are expected to fight for status and resources which can then be used to attract mates.

With regard to indirect aggression, evolutionary theorists argue that females do not stand to gain by fighting for additional copulations. Furthermore, injury (or death) resulting from fighting is likely to (or will definitely) 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 contest over scarce resources—whether material or social resources—they are expected to use methods such as ostracism and gossiping, which are less likely to result in physical injury (Campbell 1999; see also Archer 2004, 2009).

Although evolutionary theories of sex differences in aggression do not deny the influence of learned behavior, they do predict that sex differences in aggression should be evident even after controlling for sex differences in learned behavior. (See Archer 2009:251–254 for a review of theories proposing interactions between evolutionary mechanisms and social learning mechanisms in explaining sex differences in aggression.)

A male bias in warfare, including warfare among hunter-gatherers, has been noted. The hypothesized universal male bias in within-group physical aggression, however, has received much less attention. We wanted to determine whether it exists in such a population—the Aka, who are also known for their strong ethics of egalitarianism and nonaggression. Although our sample sizes would likely be too small to detect small-to-moderate female biases in indirect aggression, we nevertheless also 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.

Within-Sex Variation in Physical Aggression: The Roles of Strength and Anger

Anger is seen by many theorists as the emotion that drives aggression (e.g., Campbell 1999). Hence, within-sex variation in aggression could be explained, in part, by within-sex variation in anger. Although a number of factors probably explain variation in anger, one of them could be an ability to aggress successfully; that is, those with an inherent ability to successfully aggress against others might become more easily angered.

According to Sell and colleagues (Sell 2006; Sell et al. 2009), anger is an adaptation designed by natural selection to negotiate present and future conflicts of interest in favor of the angry individual. The anger system accomplishes this by strategically deploying the two primary tools of negotiation: the infliction of costs and the withdrawal of benefits (or threats to do either). These strategies function to recalibrate mechanisms in the target of anger so the target becomes less willing to impose costs on the angry individual.

There are many ways to inflict costs on another individual, but a particularly common, evolutionarily recurrent cost was that imposed by physical aggression. Because those individuals possessing a greater ability to physically aggress could negotiate conflicts of interest with more success, one would predict they should set a lower threshold for anger: in other words, physically stronger individuals should experience more anger, which then results in more physical aggression.

In a population of US undergraduates, Sell et al. (2009) found that, among men (but not women), physical strength was a positive predictor of both anger and

physical aggression. Similar results were found among East Indians (Archer and Thanzami 2007). We attempted to replicate these results in a population of adult foragers. 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.

Aggression among Foragers

Research on within-group aggression among foraging populations frequently emphasizes its absence (Montagu 1978). In the 17 years that Hill and Hurtado worked with Ache foragers, for example, they never observed a scuffle between Ache men. During the earlier period, though, when the Ache lived in the forest rather than in organized settlements, in-group killings accounted for 10% of all adult female deaths and 11% of adult males deaths, with club fights the single most important cause; in comparison, external warfare accounted for 37% of deaths (Hill and Hurtado 1996).

In a study of toddlers in Bofi foragers of the Central African Republic, Fouts and Lamb (2009) found that aggressive interactions were quite rare, with no significant sex differences. They speculate that the multi-aged playgroups of these foragers might serve to better control conflict compared with the more uniform ages of toddlers in Western preschool and childcare settings.

According to Turnbull (1978), physical violence among Mbuti foragers is manifested primarily by adult men, and, recognizing it as a potential problem, the Mbuti actively discourage it through teaching and rituals that occur over the course of development. Turnbull views aggression as a consequence of the inherent conflict between the individual and social self that Mbuti 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.

Many studies describing the relative 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. Mbuti children, for example, use ridicule and nicknames to promote equality of status, a pattern that continues into adulthood (Turnbull 1978).

In contrast to within-group aggression, between-group aggression (i.e., 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 whether warfare was equally common among prehistoric hunter-gatherers (Ember and Ember 1997), but it appears likely that the recent past, at least, was characterized by even greater violence (Gat 1999; McCall and Shields 2008; Walker 2001). Wrangham et al. (2006) found that the median annual mortality rate from intergroup aggression among twelve hunter-gatherer societies was 164 deaths per 100,000 (with a mean of 249). Bowles (2009) similarly

estimated that the fraction of adult mortality owing to warfare among fifteen archaeological populations, dated to between 16,000 BP and 238 BP, ranged from 0 to 0.46, with a mean of 0.14. For the eight ethnographic populations, the fraction ranged 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 (because 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,"[1] is between 15,000 and 30,000 (Bahuchet 1985), although accurate census is challenging owing to frequent camp changes. The Aka are culturally and linguistically unique, but they 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 1996). Unlike other hunter-gatherers in the area, who practice bow hunting, the Aka practice net-hunting, in which men, women, and children participate.

An Aka camp averages between 20 and 35 individuals, or about six to eight households (Bahuchet 1990; Hewlett et al. 2000). Camps are distributed along foot trails that radiate out from a farming village into the forest. Aka bring hunted and gathered forest products into the village along these trails; these products are then traded for garden products that move out along the trails. The Aka obtain a large proportion of vegetable foods, and hence calories, via such trade. The Aka therefore have a mutually dependent relationship with the Bantu farmers of the region (in this study area, the Ngandu), yet they retain their cultural independence.

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 they maintain this ethic through prestige avoidance, demand sharing (demanding that someone share food, tobacco, or other valuable resources), and rough joking (Hewlett 1991).

There is a clear emphasis on the avoidance of physical aggression among the Aka. For example, physical aggression directed at a child can be grounds for divorce. The Aka contrast themselves with neighboring Ngandu, whom the Aka view as quite

[1] The term *pygmy* is now viewed as derogatory, but no suitable replacement has yet emerged.

physically aggressive, and from whom the Aka attempt to distance themselves with regard to aggression norms. Domestic violence is frequently observed among the Ngandu, yet it has rarely been observed among the Aka. When it does occur among the Aka, it is often when one spouse fears losing his or her spouse 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 woman is hit by a man she is likely to hit him back (Hewlett and Hewlett 2008).

The widespread ethic of food sharing is maintained primarily through reputational effects (Meehan 2005; Shannon 1996). Demand sharing among foragers might 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) because relatives would come and request food at harvest time (Karen Lupo, Anthropology, Washington State University, 2009). In addition, gossip likely serves competitive aims among the Aka. For example, gossiping about a mate competitor's ill-health and physical unattractiveness occurs commonly among adolescents—in other words, those enmeshed in mate competition (Bonnie Hewlett, Anthropology, Washington State University, 2008). Anger and expressions of physical aggression are actively discouraged among the Aka. Some informants mentioned that being angry was problematic because it could divide a camp and allow sorcerers to gain power.

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 et al. 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 Bombalongo 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 the 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 (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, 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 height, weight, and physical strength of all targets were measured. Most of our participants also acted as "raters"—in other words, provided ratings of target participants on the aforementioned measures of aggression and anger. To limit potential confounds involving age-related differences in physical size and social status, 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).

Funding, the length of our field season, and the dispersed nature of Aka camps limited the number of study participants to about 100 individuals, which would provide high statistical power to detect the large sex differences typically seen in physical aggression, but low power to detect the much smaller sex differences typically seen in indirect aggression. See Table 1 for a breakdown of targets by age and sex. Raters included 79 of these 98 Aka: 20 children (10 male), 21 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).

Some child participants were at first hesitant to rate; in these cases, parents were invited to sit with their child during the interview but instructed not to answer for their child. In addition, one adolescent female at first refused to participate but agreed the next day to conduct her ratings. Three adults had difficulty in comprehending the pile-sort methodology; two were excluded following an abbreviated interview, and we modified the methodology with the third by spreading out the photographs and having him point to individuals rather than sorting into piles.

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

	N (targets)	Male, Female	Age range	Mean age	SD (age)
All ages	98	47, 51	5.5–39	18.1	8.54
Children	32	15, 17	5.5–12	8.9	1.92
Adolescents	26	12, 14	12.5–18	16.3	1.48
Adults	40	20, 20	19–39	26.6	5.66

Procedures: Qualitative Data, Semistructured Interviews

The qualitative data reported here are a subset of written field notes taken during this study and other studies with this same population. To get open-ended, qualitative responses on perceptions of aggressive behavior specifically, we asked each rater what was the worst thing one Aka could do to another.

Procedures: Quantitative Data and Variables

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.

Because the Aka are almost completely unfamiliar with questionnaires, we decided to employ a pile-sort technique. Each rater had a picture of each of the targets of their own age category in front of them, who were about evenly divided by sex. These target photos represented a large fraction of the individuals living along the Bombalongo trail. Photos were presented to raters, one at a time, and the raters were asked if the person in the photo committed the specific aggressive act (e.g., hitting, gossiping, and/or excluding others) more or less frequently than most Aka, and, for adults only, whether the person in the photo became more or less angry than most Aka.[2] "Exclude" was described as "not allowing him/her to join a playgroup." (We did not measure exclusion among adults because it did not map clearly to an identifiable social phenomenon in Aka culture.)

Thus, all ratings were on a binary scale (0, 1). 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.

We were also interested in whether Aka had any stereotypes about sex differences in aggression—that is, did they think men and women tend to behave in certain ways? To assess Aka stereotypes, if any, about sex differences 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 differences in aggression could be explained by sex differences in social norms against aggression, we asked all raters to indicate, on a five-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). Note that whereas our measure of stereotypes addressed what participants thought people *tend* to do, our measure of norms addressed what participants thought people *ought* to do.

Finally, we measured the height, weight, and upper body strength of all 40 adult targets. Strength was measured using a modified hand press (a JAMAR Hand Dynamometer) shown by Sell et al. (2008) to be an accurate indicator of overall strength.

[2] Note that we did not specify whether "most other Aka" included only Aka in one's own age category.

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), with the caveat that we had low statistical power to detect the small sex differences usually seen in indirect aggression. We predicted these biases would persist after controlling for hitnorm, gosispnorm, and excludenorm, respectively. Because norms against aggression should deter aggression, we 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 we asked only raters about aggression norms. 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's (2004) meta-analysis of the numerous studies of sex differences in physical and indirect aggression provides mean effect sizes (*d*) for sex differences in aggression, broken down by type of aggression, by type of study (e.g., observational, self-report, peer-report), and by age categories. We computed our power to detect these effects; we also computed the effect size we could detect with the conventional values of power=0.8 and alpha=0.05 (Table 2). As can be seen in the table, our total sample size provided high power to detect the large sex difference usually seen in physical aggression, but low power to detect the relatively small sex difference usually seen in indirect aggression, which would have required about 700 participants to detect with adequate power. Nevertheless, we did check for sex differences in both types of aggression. Within age categories, our statistical power was obviously much lower due to the smaller sample sizes, but still high enough to provide a reasonable chance of detecting the large sex differences often found in physical aggression among children and adolescents. With 40 adults, we had adequate power to detect the effect of strength on anger, $r=0.38$, found by Sell et al. (2009).

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

Table 2 Power analysis for sex differences in aggression. The mean effect sizes 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. Effect size for strength vs. anger is from Sell et al. (2009). We computed our power to detect these effects within and across age categories. We also computed the effect sizes we could detect with power=0.80 and alpha=0.05, which are listed in the final column

	Mean effect size (*d*) in previous studies	Sample size in current study	Power to detect mean effect	Effect size (*d*) detectable with power=0.8
Sex differences in physical aggression				
All ages (self-report/peer-report)	0.59/0.80	98	0.90/0.99	0.51
Children	0.69	32	0.60	0.90
Adolescents (younger/older)	0.82/0.97	26	0.65/0.78	1.01
Adults (younger/older)	0.60/0.25	40	0.59/0.19	0.80
Sex differences in indirect aggression				
All ages (peer-report)	−0.19	98	0.24	
Children	0.00	32	–[a]	−0.90
Adolescents (younger/older)	−0.13/−0.35	26	0.093/0.22	−1.01
Adults	−0.01	40	0.05	−0.80
Strength vs. anger				
Adults	r=0.38	40	0.79	r=0.39

[a] For children, not applicable

do to another, along with not sharing, stealing food or husbands/wives, and sorcery. The latter are frequently cited as the causes of hitting or gossiping.

Among children, causes of hitting include fun, being "provoked," because someone hit you, refusing to work, dominance relationships, and no reason. 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. As with 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 toward 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 out of 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 wives or husbands 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 they 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.

Summary Statistics

All statistics were computed using R 2.9.0. Summary statistics for study variables are presented in Table 3.

Inter-Rater Reliability for Peer-Ratings of Hitting, Gossiping, Exclusion, and Anger

We measured inter-rater reliability of peer-ratings in two ways. First, we segregated raters by sex, exploring whether male and female raters rated targets differently. The correlation of male and female ratings of hitting by all targets was $r=0.81$, $p<0.001$; of hitting by male targets only, $r=0.83$, $p<0.001$; and of hitting by female targets only, $r=0.78$, $p<0.001$. The correlation of male and female ratings of gossiping by all targets was $r=0.65$, $p<0.001$; of gossiping by male targets only, $r=0.68$, $p<0.001$; and of gossiping by female targets only, $r=0.69$, $p<0.001$ (exclusion was not measured in adults). Hence, male and female raters largely agreed on targets' propensity to hit and gossip, regardless of target sex. We therefore combined the ratings of male and female raters in all analyses.

Table 3 Summary statistics for study variables

Variable	N	Range	Mean	SD
Hit	98	0.11–0.86	0.51	0.19
Gossip	98	0.13–0.88	0.50	0.15
Exclude	58	0.14–0.87	0.46	0.17
Hitnorm	79	1–5	3.70	1.31
Gossipnorm	79	1–5	3.17	1.15
Excludenorm	40	1–5	2.55	1.08
Anger	40	0.19–0.76	0.49	0.15
Strength (kg)	40	0–42.2	20.45	9.81
Height (cm)	40	136.1–169.1	150.0	7.17
Weight (kg)	40	30.5–60.0	45.4	5.85
BMI	40	16.4–23.53	20.13	1.79

Second, we assessed inter-rater reliability using intraclass correlations (ICC, type 2,k), equivalent to Cronbach's alpha or, for our dichotomous ratings, Kuder-Richardson Formula 20. Since children only rated children; adolescents, only adolescents; and adults, only adults, these could only be computed within age categories. Inter-rater reliability was acceptable to high for all measures among adults, but poor to moderate for children and adolescents (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) but below the "rule of thumb" cutoff for Cronbach's alpha, usually taken to be 0.6 or 0.7. Because our raters had lifelong personal relationships with the targets, 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." We note that noise generally makes it more difficult to detect effects, such as sex differences in aggression.

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.

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

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)

	ICC (all raters)	Raters removed	ICC (subset)	95% CI
Children				
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
Adolescents				
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
Adults				
Anger	0.71	0 of 37	–[a]	0.57–0.83
Hits	0.88	0 of 37	–	0.82–0.93
Gossips	0.63	0 of 37	–	0.45–0.78

[a] For adults, not applicable

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 the variable Exclude (Table 5).

Prediction 1: Was There a Male Bias in Physical Aggression?

Supporting prediction 1, in the sample as a whole there was a strong, significant male bias in hitting (Table 6), with an effect size that was similar to the average seen in other peer-report studies (d=0.73 vs. 0.80 in Archer 2004). As can be seen in Fig. 1a, male physical aggression differed maximally from females at about age 15, and peaked about age 20. Both patterns are similar to those seen in other populations (Archer 2004). The sex difference in hitting was also significant in children and adolescents separately, but not in adults (Table 6). The effect in adults trended in the predicted direction, however, and was of a magnitude comparable to that found in other studies of middle-aged adults (d=0.22 vs. = 0.25 in Archer 2004). The smaller sex difference in hitting in adults compared with children and adolescents appears to be a consequence of both an increase in hitting in adult women and a decrease in adult men (Fig. 1a).

Because inter-rater reliability was low among children and adolescents, we were concerned that a small number of raters in these age groups could have given exceptionally high or low aggression ratings to targets of one sex, thus creating the large sex difference we found in juveniles. However, a significant majority of child and adolescent raters, 31 of 41, rated males as hitting more than females (p=0.001, binomial test), indicating strong agreement about a male bias in hitting even if agreement on the hit ratings for particular targets was low. Among adult raters, in

Table 5 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. Adults were not asked about exclusion as it did not map onto an indigenous category of aggression. *p<0.05; **p<0.01, ***p<0.001

Aggression type	Females more	Males more	Both equally	χ^2	df	p
All ages						
Hit	14	40	23	13.6	2	0.001***
Gossip	48	8	22	28.5	2	<0.001***
Children						
Hit	8	7	5	0.7	2	0.70
Gossip	13	4	3	9.1	2	0.01**
Exclude	11	4	5	4.3	2	0.12
Adolescents						
Hit	3	13	4	9.1	2	0.01**
Gossip	15	2	3	15.7	2	<0.001***
Exclude	9	5	6	1.3	2	0.52
Adults						
Hit	3	20	14	12.1	2	0.002**
Gossip	20	2	16	14.1	2	<0.001***

Table 6 Sex-differences in peer-ratings of aggression and anger, as well as our objective measure of upper body strength (two-tailed *t*-tests). *$p<0.05$; **$p<0.01$, ***$p<0.001$

Variable	Male mean	Female mean	*t*	df	*d*	*p*
All ages						
Hit	0.58	0.45	3.58	95.6	0.73	0.0005***
Gossip	0.50	0.50	0.17	92.6	0.03	0.87
Children						
Hit	0.54	0.39	3.06	29.5	1.12	0.005**
Gossip	0.52	0.47	0.69	29.7	0.25	0.49
Exclude	0.48	0.41	1.16	28.6	0.43	0.26
Adolescents						
Hit	0.61	0.40	4.23	23.6	1.73	0.0003***
Gossip	0.50	0.48	0.33	22.5	0.13	0.74
Exclude	0.51	0.45	0.93	17.5	0.40	0.36
Adults						
Hit	0.58	0.54	0.67	37.8	0.22	0.51
Gossip	0.50	0.53	−0.87	37.5	−0.28	0.39
Anger	0.52	0.46	1.29	37.4	0.42	0.20
Strength (kg)	25.5	15.4	3.79	35.3	1.23	0.0006***

contrast, only 20 of 37 rated males as hitting more than females, a small majority that was not significantly different from a 50–50 split ($p=0.7$, binomial test).

To test whether the sex difference in hitting could be explained by sex differences in social norms against hitting, we first compared mean hitnorm in males (M=3.67) vs. females (M=3.75), finding no significant difference, $d=0.064$, $t=0.28$, df=76.9, $p=0.78$ (two-tailed). (We only collected norm data from the raters who were also targets.) We then tested for an effect of sex on hit after controlling for hitnorm (Table 7). Just as with the simple means tests, the male bias was still significant in the entire sample of raters, as well as in children and adolescents, but not in adults (Table 7). As predicted, hitnorm had a significant negative effect on the variable Hitting in adults, but not in the entire sample of raters, nor in children and adolescents, although the effect trended in the predicted direction in all cases.

Interestingly, Fig. 1a reveals that between the ages of 15 and 20, females seemingly exhibit a sharp increase in physical aggression. To test whether this increase was significant, we compared adult female (age>18) mean hit scores (M=0.54) with younger female (age≤18) mean hit scores (M=0.39). The difference was large and significant, $d=0.88$, $t=2.75$, df=29.6, $p=0.01$. Although this finding may reflect differences in adult vs. juvenile raters rather than differences in the targets, there is no similar sharp increase in ratings of male physical aggression, which instead increase smoothly with age among children and adolescents, decreasing among adults (Fig. 1a). We tested whether the latter curvilinear pattern was significant by fitting a multiple regression model with linear and quadratic age terms. These terms were only marginally significant, however, and the model explained just 3% of the variance in male hit scores (test not reported).

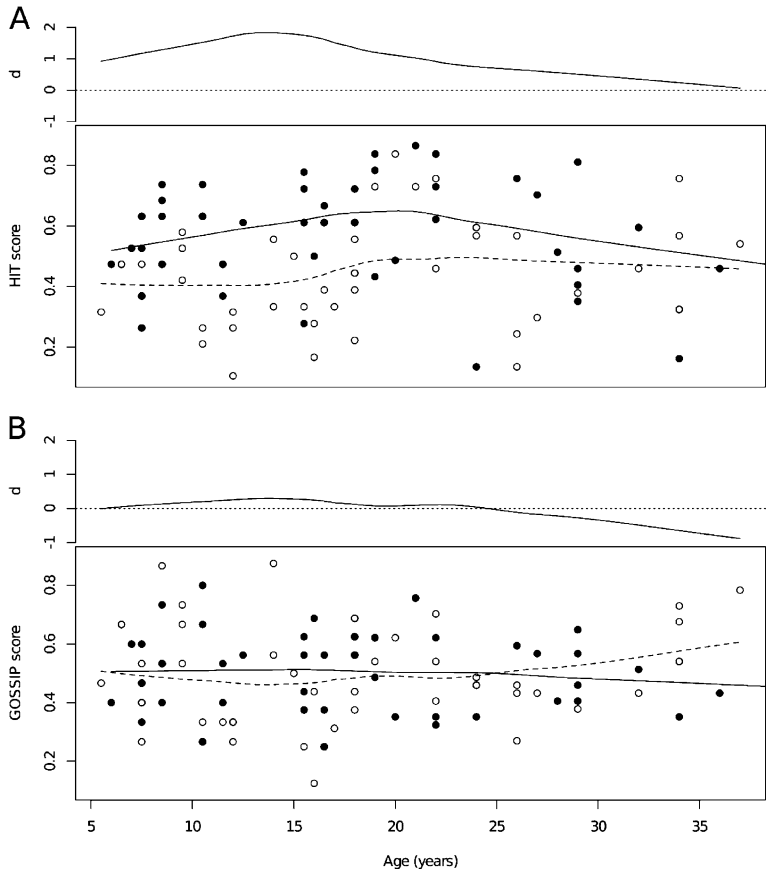

Fig. 1 Peer-rated aggression vs. age. **a** female and male hit scores vs. age, along with the estimated sex difference (*d*) vs. age. **b** female and male gossip scores vs. age, along with the estimated sex difference (*d*) vs. age. Males: *closed circles*, *solid lines*. Females: *open circles*, *dotted lines*. Lines fit by loess regression. Ages are approximate (see text)

Prediction 2: Was There a Female Bias in Indirect Aggression?

Contrary to prediction 2, there was no sex difference in gossiping in the entire sample (d=0 vs. −0.19 in Archer 2004), nor in any age category (Table 6 and Fig. 1b). In children and adolescents, the effects trended in the opposite direction, with boys gossiping slightly more than girls.

In adults, the effect, though not significant, trended in the predicted direction and was of a magnitude similar to those seen in self-report studies of community samples (d=−0.28 vs. −0.22 in Archer 2004). If this effect is real, it appears to be due to an increase in gossiping in older women and a decrease in older men (Fig. 1b). (See also results for prediction 3 below.) Controlling for age and gossipnorm, sex was still not a significant predictor of gossip (test not reported). Controlling for hit, which was strongly positively correlated with gossip (see prediction 6 below), revealed a marginally significant female bias in gossiping (p=0.06).

Contrary to predictions, gossipnorm was not significantly negatively correlated with gossip (r=−0.039, p=0.73). Exclude was only measured in children and

Table 7 Multiple regression models of hit as functions of sex, norms, anger and strength in different age groups. Estimates for interval variables are regression coefficients; for categorical variables they are treatment contrasts

	Estimate	SE	*t*	*p*
Model 1: All ages				
(Intercept)	0.54	0.07	8.11	<0.001***
Sex (m)	0.13	0.04	3.17	0.002**
Hitnorm	−0.03	0.02	−1.62	0.11
Model 2: Children				
(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
Model 3: Adolescents				
(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
Model 4: Adults				
(Intercept)	0.79	0.12	6.67	<.001***
Sex (m)	0.04	0.07	0.64	0.53
Hitnorm	−0.06	0.03	−2.37	0.02*
Model 5: Adults				
(Intercept)	−0.09	0.10	−0.91	0.37
Anger	1.27	0.22	5.70	< 0.001***
Strength (high)	0.49	0.16	3.01	0.005**
Anger*Strength	−0.80	0.32	−2.52	0.02*

Model 1: residual standard error (RSE)=0.19 on 76 df, multiple R^2=0.15, adjusted R^2=0.12, F=6.52 on 3 and 76 df, p=0.002.Model 2: RSE=0.15 on 17 df, multiple R^2=0.33, adj. R^2=0.25; F=4.15 on 2 and 17 df, p=0.034.Model 3: RSE=0.14 on 18 df, multiple R^2=0.43, adj. R^2=0.37, F=6.75 on 2 and 18 df, p=0.006.Model 4: RSE=0.20 on 35 df, multiple R^2=0.15, adj. R^2=0.11, F=3.18 on 2 and 35 df, p=0.054. Model 5: Strength was dichotomized on the median. Healers included.RSE=0.14 on 36 df, multiple R^2=0.60, adj. R^2=0.57, F=18.28 on 3 and 36 df, p<0.001

*p<0.05; **p<0.01, ***p<0.001

adolescents. Contrary to prediction 2, girls did not exclude more than boys, and results actually trended slightly in the opposite direction (Table 6).

Prediction 3: Did Anger Predict Hitting and Gossiping?

Anger should motivate aggression (prediction 3). We measured anger only in adults. In support of prediction 3, anger correlated positively with both hit (r=0.70, p<0.001) and gossip (r=0.71, p<0.001). These results confirm that both behaviors are viewed as aggressive. Although there were no significant sex differences in anger (Table 6), these results also suggest that anger might nevertheless be an important control variable when exploring sex differences in aggression. We therefore revisited predictions 1 and 2, computing models of hit

and gossip as a function of sex, this time 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 8).

Prediction 4: Did Strength Predict Anger and Hitting?

High upper-body strength lowers the cost of physical aggression. Strength should therefore positively correlate with anger and hitting, at least for males (prediction 4). For the entire sample (men and women), there was a positive, albeit nonsignificant, correlation (r=0.21, p=0.10), contrary to prediction 4. However, inspection of the scatterplot (Fig. 2a) revealed three male outliers on strength. All three were traditional Aka healers. The mean healer strength, 41.1 kg, was 2.75 standard deviations (SDs) above the mean strength of male non-healers, 22.8 kg, or 80% greater. Despite being very strong, the healers' mean anger (M=0.37) was 1.3 SDs below the mean anger score for male non-healers (M=0.54). Both differences were statistically significant, t=9.6, df=18, p<0.001; t=3.4, df=7.4, p=0.01, respectively.

If healers, who were clear outliers on both strength and anger, were removed from the analysis (see "Discussion"), the positive correlation between upper body strength and anger was significant (r=0.45, p=0.0025). There was no significant main effect of, or interaction with, sex (multiple regression test 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). There were no significant correlations between anger or hit and height, weight, or BMI alone or controlling for sex (with or without the healers). Finally, adult men were significantly physically stronger than adult women (Table 6).

The Effect of Strength on Hitting: Is Anger a Mediator? In adults, strength also positively correlated with hitting, r=0.37, p=0.01 (Fig. 2b). Separately, the correlations between strength and hitting for men and women were somewhat different (r=0.43 vs. 0.28, respectively), being significant for men (p=0.03) but not for women (p=0.11). However, because there were no significant main effects of, or interactions with, sex (multiple regression test not reported), we cannot reject the null hypothesis that the effect of strength on hitting is the same for men and women. Revisiting prediction 1 for adults, we tested the effect of sex on hitting,

Table 8 Regression model of adult gossip as a function of sex and anger. Estimate for anger is a regression coefficient; for sex it is a treatment contrast. Residual standard error=0.086 on 37 df, multiple R^2=0.60, adjusted R^2=0.57, F=27.21 on 2 and 37 df, p<0.001

	Estimate	SE	t	p
(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***

*p<0.05; **p<0.01, ***p<0.001

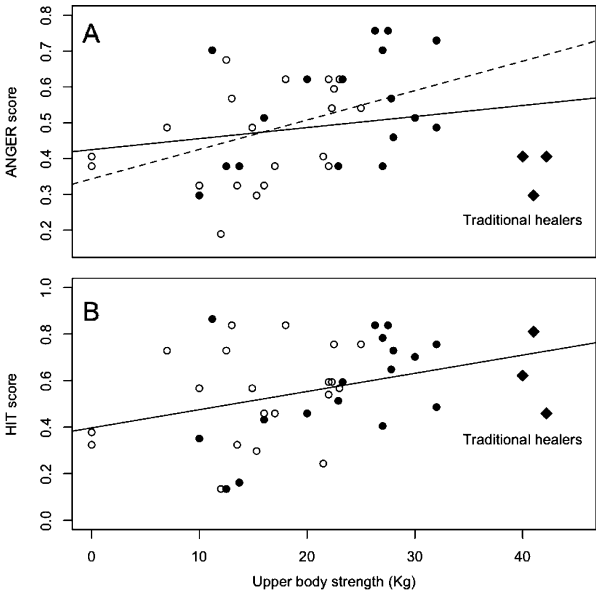

Fig. 2 Strength vs. anger and hit. **a** Peer-rating of anger vs. upper body strength for adult Aka men (*solid symbols*) and women (*open symbols*). *Solid line* fit by linear regression. including traditional healers (*diamonds*). *Dotted line* fit by linear regression excluding traditional healers. **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

now controlling for both strength and anger, but there was still no significant sex difference in hit (test not reported).

Given that strength positively correlated with anger (prediction 4), and anger positively correlated with hitting (prediction 3), it was possible that the effect of strength on hitting 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 without healers and one with them included (Fig. 3). As can be seen in Fig. 3, when healers are excluded the effect of strength on hitting is entirely mediated by the effect of strength on anger, consistent with Sell (2006), who argued that high physical strength is a *cause* of anger, which, in turn, is a cause of hitting. With healers included, strength has an effect on hitting independent of its (non-) effect on anger. Interestingly, despite having low anger for their strength, healers' hit scores are consistent with their strength (Fig. 2b)—healers are strong, are perceived to hit more than most Aka, but are not perceived as angry.

The Effect of Anger on Hitting: Is Strength a Moderator? An alternative hypothesis, suggested by a reviewer, is that strength does not cause anger but instead moderates the effect of anger on hitting. Perhaps all people experience the same anger for a given provocation, for example, but only the strong actually act on their anger by hitting. If so, the relationship between anger and hitting should differ between the strong and the weak. To test this hypothesis, we computed a multiple regression model of hitting as a function of anger, strength, and their interaction. The main and interaction terms were significant, indicating that strength did moderate the effect of anger on hitting: at low anger levels, the strong were more likely to hit than the weak, an effect that diminished at high anger levels (Table 7, model 5, and Fig. 3c). This moderation was sensitive to a single outlying healer, however (Fig. 3c). With this single healer removed,

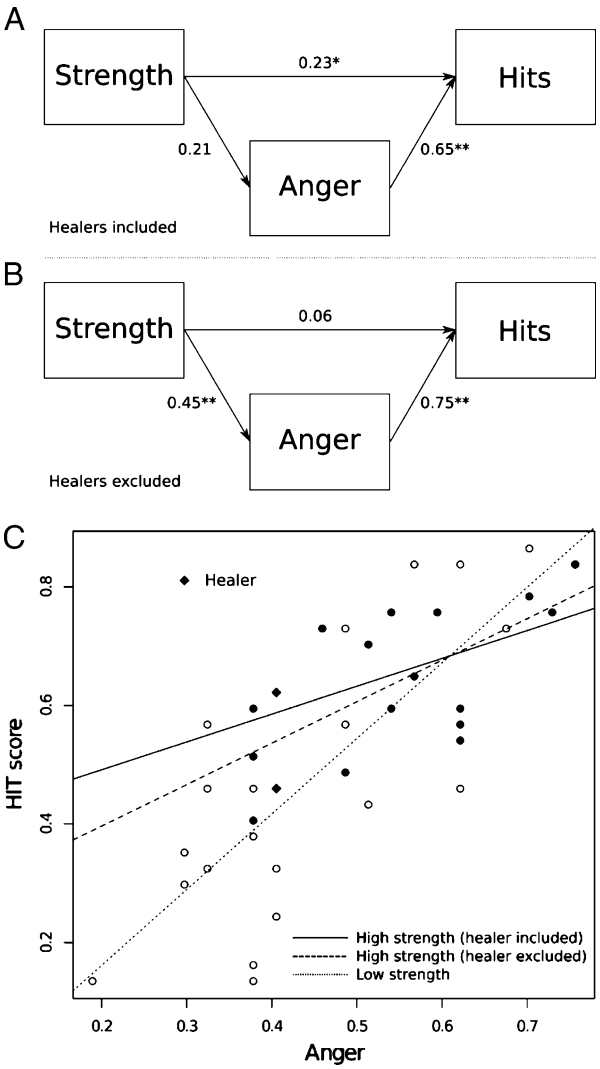

Fig. 3 The mediating and moderating relationships among strength, anger, and hitting. **a**, **b** Path models of hitting as a function of strength among adults, mediated by anger. **a** With healers included, anger does not mediate the effect of strength. **b** With healers excluded, anger does mediate the effect of strength. **c** Hitting as a function of anger, moderated by strength (dichotomized about the median). *Open symbols*: low strength. *Closed symbols*: high strength. *Diamonds*: healers (high strength). *Dotted line*: regression of anger vs. hit for low strength. *Dashed line*: regression for high strength (outlying healer excluded). *Solid line*: regression for high strength (outlying healer included). The dotted and dashed regression lines are not significantly different; the dotted and solid regression lines are significantly different (Table 7, model 5). *$p<0.05$; **$p<0.01$

strength and its interaction with anger had no significant effect on hitting (test not reported).

Prediction 5: Was Strength Negatively Correlated with Gossiping?

If indirect aggression is a safer alternative to physical aggression, then physically weaker individuals might be expected to use gossip more than stronger individuals, who would instead rely on physical aggression (prediction 5). Contrary to prediction 5, however, there was no significant negative correlation between strength and gossip, and the effect trended in the opposite direction: among all adults, $r=0.02$, $p=0.92$; all adults excluding healers, $r=0.21$, $p=0.22$; and for women only, $r=0.37$, $p=0.11$. 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).

Prediction 6: Was Hitting Negatively Correlated with Gossiping?

By the same logic underlying prediction 5, hitting and gossiping should be negatively correlated (prediction 6). Contrary to prediction 6, there was a significant positive, rather than negative, correlation between hit and gossip in the entire sample, $r=0.50$, $p<0.001$; for all females, $r=0.58$, $p<0.001$; for all adults, $r=0.56$, $p=0.002$; and for adult women only, $r=0.60$, $p=0.005$. However, as shown above, hit and gossip were confounded with anger (which was only measured in adults). After controlling for anger, there was no significant relationship between hit and gossip in adults, although the effect still trended in the positive direction, again contrary to our hypothesis; adding sex to the model did not change this (tests not reported).

Discussion

We found a large male bias in hitting, even after controlling for social norms against hitting. In fact, there were no significant sex differences in any social norms in any age category. These results support the view that a male bias in physical aggression is probably a human universal, and one that is not well explained by a sex difference in social norms. Aka adolescents and adults (but not children) also perceived males to hit more than females.

One important caveat is that although we found an adult male bias in physical aggression of a magnitude similar to that found in other studies of middle-aged adults ($d=0.22$ vs. 0.25 in Archer 2004), it was not significant, perhaps owing to our small adult sample size and the small effect size. Alternatively, there might be no sex difference in physical aggression among Aka adults. In adulthood, men in many societies increasingly rely on political skills and resources to obtain mates (e.g., Chagnon 1997), perhaps reducing the value of physical aggression in some cases. Our data seem to indicate a steady decrease in physical aggression among adult men (Fig. 1a). Moreover, Aka men have the highest known levels of paternal investment (Hewlett 1991). As there is a trade-off 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. Finally, our data show a significant increase in physical aggression among adult women compared with juveniles (Fig. 1a), which probably reflects marital conflict.

Despite the fact that Aka of all age categories stereotyped females as gossiping more, there was no significant sex difference in peer-reported gossiping or exclusion. Because the sex difference typically found in studies of indirect aggression is small, and is usually detectable only in studies including several hundred females and several hundred males, we did not expect to detect it in our study. After controlling for anger, however, there was a significant female bias in gossiping among adults, which was somewhat surprising (we did not measure anger in children or adolescents). This result suggests that controlling for anger could be important in future studies of sex and indirect aggression. In the entire sample, after controlling for hitting, a marginally significant female bias in gossiping appeared, suggesting that physical aggression might also be an important control variable in future studies of indirect aggression (see also Smith et al. 2009).

As predicted, physical strength significantly positively correlated with physical aggression (r=0.37). In males alone, the effect was somewhat larger (r=0.43) and still significant, but in females, it was smaller and no longer significant (r=0.28). However, we did not find a significant main effect of, or interaction with, sex. We therefore 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 all extreme outliers on physical strength; second, despite high peer-ratings on physical aggression, they all had exceptionally low peer ratings on anger (Fig. 1a, b). These results hint that Aka healers might be physiologically and emotionally distinct from other Aka. If so, this unexpected finding is important in its own right. Although we do not know why the healers exhibited these patterns, we speculate post hoc that they might be due to advantages available to healers, as well as the distinct role healers play in Aka society. By catering to local villagers and even clients from distant cities, healers 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 advantages, 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 because the healers are not attempting to adjust others' behavior with respect to themselves but instead with respect to other group members. The possible physiological and emotional differences between healers and other Aka are important topics for future study.

If we removed healers from the analysis, strength was then significantly positively correlated with anger (r=0.45), 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 we 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.

Our finding that, among non-healers, anger completely mediated the effect of strength on hitting (Fig. 3b) supports Sell's (2006) hypothesis that strength lowers one's threshold for anger, which then causes physical aggression. There were two caveats, however: 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 et al. 2009). An alternative model, in which the strong and the weak are equally likely to experience

anger, but only the strong actually express it by hitting, was supported for our entire adult sample, where the strong were more likely to hit at low anger levels than the weak (Fig. 3c). However, this model was again sensitive to the inclusion of healers. Excluding a single outlying healer rendered the main and interaction effects of strength nonsignificant. In summary, Sell's model is best supported among non-healers.

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, we found a significant *positive* correlation between hitting and gossiping (which, in adults, disappeared after controlling for anger) and no significant correlation between strength and gossiping. In a meta-analysis of aggression studies among children and adolescents, Card et al. (2008) similarly found a positive correlation between physical and indirect aggression. 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. An alternative hypothesis is that indirect aggression is often superior to physical aggression for within-group conflicts among both men and women, whereas for between-group conflicts, largely the province of men, physical aggression is often superior (Hess 2006; Hess and Hagen n.d.).

Our study had several limitations. Most important, 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 size was also modest, preventing us from detecting small-to-moderate effect sizes typical of sex differences in indirect aggression, or physical aggression among older adults. In addition, peer reports of anger can only assess the expressed anger of others, not the internal emotional states of targets. Also, owing to time constaints, we chose not to explore gender-specific social norms (e.g., "How wrong is it for men to hit?" "How wrong is it for women to hit?").

Finally, inter-rater reliability was high among adult raters but low to moderate among child and adolescent raters. We are not sure why. The same two investigators (CH and 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). 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. The fact that eliminating a relatively few child and adolescent raters dramatically improved inter-rater reliability in most cases also suggests that some juveniles might 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. Also, despite only modest agreement on the hit ratings of particular individuals, a significant majority of children and adolescent raters nevertheless rated males as hitting more than females.

Overall, we found strong support for the hypothesis that a male bias in physical aggression is a human universal unexplained by a sex difference in social norms, at least in children and adolescents, but not necessarily 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). Our results, however, did not support the idea that indirect aggression is a safer alternative to physical aggression. Finally, with the exception of healers, physical strength was positively correlated with anger, which, in turn, positively correlated with physical aggression (Sell et al. 2009).

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