



Original Article

Body counts in lowland South American violence

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ABSTRACT

Violence was likely often a strong selective pressure in many traditional lowland South American societies. A compilation of 11 anthropological studies reporting cause of death shows that violence led to about 30% of adult deaths, of which about 70% were males. Here violent deaths are further itemized at the level of ethnographically-reported death events (particular duels, homicides, and raids) to provide more detailed insight into the causes and consequences of within- and between-group violence. Data for 238 death events (totaling 1145 deaths) from 44 lowland South American societies show that attacks are more deadly when treachery is used, when avenging a previous killing, and on external warfare raids between ethnolinguistic groups. That revenge raids kill more people on average than the original grievance, at least when conflicts are between ethnolinguistic groups, indicates a tendency towards increasingly vicious cycles of revenge killings. Motives of killings as noted in ethnographic sources, in order of importance, reportedly include revenge for previous killings and other wrong-doings like sorcery, jealousy over women, gain of captive women and children, fear or deterrence of impending attack, and occasionally the theft of material goods. Results may have implications for understanding the potential for multi-level selection by delineating the force of competition at varying scales of analysis within and between lowland South American societies.

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1. Introduction

Amazonian anthropology has long been central to understanding the nature of warfare in pre-state human societies. The classic raiding experience in Amazonia (glossed loosely here as tribal warfare) was for a group of men to attack an enemy village at dawn, kill several enemies, and quickly retreat into the forest to avoid a counter-attack (Chagnon, 1968; Larrick, Yost, Kaplan, King, & Mayhall, 1979; Ross, 1988; Conklin, 1989; Verswijver, 1992; Fausto, 2001; Beckerman & Yost, 2007; Beckerman & Valentine, 2008). The “Great Protein Debate” crystallized an argument between those that saw tribal warfare among the Yanomamo and other Amazonian societies as population control in response to low-density protein availability (Harris, 1974; Gross, 1975) versus those that argued for plentiful protein availability (Beckerman, 1979) with warfare as a strategy for status striving and capturing wives (Chagnon & Hames, 1979). Yet another argument saw warfare as more novel, driven primarily by competition for European goods like machetes and shotguns (Ferguson, 1995). The perspective taken here is that warfare was traditionally a persistent feature of many tribal societies in lowland South America well before 1500AD and even more paramount in chiefdoms that collapsed

during the early stages of European colonization (Carneiro, 1981; Hemming, 1978; Redmond, 1994; Balée, 2007).

Comparative ethnographic information on actual death events may help shed light on the proximate and ultimate causes of violence. By “death event” we refer to activity that led to violent death(s) as recorded ethnographically such as a particular duel, homicide, or warfare raid. Event-level analyses may provide some information for evaluating two recent evolutionary models of intergroup aggression. One of these, the “chimpanzee model” (Wrangham, 1999; Wrangham & Glowacki, 2012), derives from repeated observations of coalitions of wild chimpanzee males killing members of neighboring communities when there is a local imbalance of power so that the killing(s) can be carried out relatively safely for the aggressors. The resultant fitness benefits may take the form of increased access to more land, food, and females and even the eventual replacement of the neighboring group (Wilson, Wallauer, & Pusey, 2004). There are several resemblances between chimpanzee and tribal warfare, including male coalitions, group territoriality, low cost but lethal intergroup killings, and similar fitness benefits, making the chimpanzee model potentially applicable to warfare in small-scale human societies (Manson & Wrangham, 1991; Wrangham & Peterson, 1996). Wrangham and Glowacki (2012) have found these chimpanzee–human similarities to hold for human hunter–gatherers and we extend this analysis here to lowland South American societies.

Another model, “parochial altruism” (Bowles, 2006, 2009; Choi & Bowles, 2007), sees widespread cooperation in human societies as the

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result of genetic group (multi-level) selection where within-group cooperation allows some altruistic groups to better displace or otherwise out-compete other more self-serving groups of individuals (Darwin, 1871; Alexander, 1974; Hamilton, 1975; Wilson & Dugatkin, 1997). Parochial altruism resembles the chimpanzee model in that aggressive male behaviors have been selectively favored through the success of more dominant groups. However, it further suggests selection for uniquely human psychological traits adapted for within-group cooperation and between-group warfare not seen in chimpanzees (Wrangham & Glowacki, 2012), potentially including self-sacrificing behaviors (Bowles & Gintis, 2011), strong reciprocity (Gintis, 2000), treachery (Wadley, 2003), cultures of honor (Nisbett & Cohen, 1996), and revenge-seeking (Beckerman & Valentine, 2008; Boehm, 2011). Here we evaluate evidence for these derived psychological mechanisms in lowland South American warfare. In general, the most salient levels of selection and the proximate and ultimate motivations of warfare are underexplored, and that is why we focus here on quantifying the intensity of competition at multiple scales of social organization within and between lowland South American societies.

2. Methods

Ethnographic literature for lowland South America was searched for event-level information of individual homicides, duels, and raids by looking through ethnographies for relevant index entries of “violence”, “war”, “killing”, “raids”, and “homicide”. Of these ethnographic works, 11 include data on the total number of deaths attributed to violence (1281, not including infanticide but including violent deaths by non-indigenous perpetrators) as a fraction of total recorded deaths (4215 deaths, Table 1). The event-level sample includes 1145 deaths of victims from 44 different ethnolinguistic groups (see compiled dataset and sources at <http://dice.missouri.edu>). Only indigenous-on-indigenous killings were included as death events, while deaths accorded to strife with European colonists were excluded. The inclusion criterion for death events is that the source must mention the body count for a particular event. Additional information recorded includes whether captive women or children were taken, number of women taken captive, motivation(s) for killing (e.g., revenge, gain, fear or deterrence), scale of conflict (within community, internal between communities in the same ethnolinguistic group, or external between ethnolinguistic groups), use of treachery (e.g., feigning friendship such as holding a malicious feast or inviting enemies to hunt or fish), and sequence of conflict when an initial killing is recognized as the impetus for a resulting

revenge killing. Motives of raids were recorded as stated in ethnographic sources and sometimes included multiple motives from one or more informants.

There are a number of potential sampling issues associated with the recording of death events. Non-lethal interactions (body count = 0) were not included in this study, and this makes within-village body counts appear higher per event than they actually are in comparison to internal and external warfare because many within-village altercations are not lethal while warfare events usually involve fatalities. Also, it is possible that informants and ethnographers are more likely to remember and mention events that are more deadly. However, the modal body count at all scales of analysis is simply 1 death, and so if there are biases towards larger body counts the effect does not appear to be serious. In addition, we were forced to assume that, if captives were not mentioned in an event, then no captives were taken. This may under-estimate the frequency of captives and the number of women taken captive in the sample. Likewise, if no use of treachery was mentioned, we assumed no treachery for that event. However, this is a conservative choice and only serves to diminish the real differences in body counts between treacherous and non-treacherous events, although there were likely unsuccessful attempts at treachery that were unable to entice victims and therefore did not enter into the sample.

Generalized linear mixed models were run in the lme4 package (Bates & Maechler, 2010) in R (Ihaka & Gentleman, 1996) with each incident cross-nested in victim's society and perpetrator's society because different societies have variable numbers of death events (random intercepts model). The dependent variable was number of victims in an event (body counts). These are count data so a Poisson link was used. For models using sequence to predict body counts, incidents were nested within conflict groups (i.e., we used a grouping variable to indicate which set of conflicts a conflict belonged to), which were nested in perpetrator's society (cross-nested models containing sequence did not converge; however, model results did not differ whether conflict groups were nested in perpetrator's group or victim's group).

3. Results

3.1. Violent deaths

Cause-of-death data focusing on violent deaths in pre-contact or more traditional time periods are available for 11 lowland South American societies (Table 1). Violent deaths include both indigenous and non-indigenous conflict in the form of duels, homicides, and raids,

Table 1
Sex-specific counts of violent deaths from both indigenous and non-indigenous conflict (including duels, homicides, and raids, but not infanticide).

Society	Violent deaths			Percent male	Total deaths	Percent violent deaths	Age range of sample	Source
	males	females	total					
Tsimane	22	8	30	73	525	6	adults (20+)	Curven, Kaplan, & Zelada Supa, 2007
Xilixana (pre-contact)	8	2	10	80	64	16	all ages	Early & Peters, 2000
Ayoreo					276	20	all ages	Bugos, 1985
Yanomamo	113	20	133	85	610	22	mostly adults	Chagnon, 1974
Wari' (pre-contact)			110		400	28	all ages	Conklin, 1989
Hiwi (pre-contact)	18	10	28	64	86	33	adults (10+)	Hill, Hurtado, & Walker, 2007
Arawete			167 ^a		477 ^a	35 ^a	all ages	Viveiros de Castro, 1992
Kayapo (pre-contact)	62	21	83	75	237	35	mostly adults	Werner, 1980
Achuar	73	33	106	69	250	42	adults	Ross, 1988
Ache (pre-contact)	44	22	66	67	153	43	adults (15+)	Hill & Hurtado, 1996
Waarani (pre-contact)	164	108	272	60	484	56	mostly adults	Larrick et al., 1979
SUM	504	224	1281		4215			
MEAN				69.2		30.4		

An emphasis is made on using earlier pre-contact periods where available (denoted in parentheses) to minimize the impacts of contact and acculturation. Different studies use different age ranges for analysis, but results are roughly comparable.

^a Indicates the inclusion of some captives, mostly women taken by Kayapo, into the death count.

but not infanticide. The percent of deaths arising from violence varies considerably from the Tsimane at 6%, the only group in the sample with no active warfare, to the pre-contact Waorani with incessant revenge raids at 56%. The average percent of violent deaths across all 11 studies is 30% indicating that violence was probably a potent selective pressure for many traditional societies. The Yanomamo have been characterized as “The Fierce People” (Chagnon, 1968) but are below the mean at 22% violent deaths. The lowland societies in this cause-of-death sample are roughly divided amongst contexts where internal strife between communities of the same ethnolinguistic group was the primary threat (Achuar, Waorani, Yanomamo) versus those where external conflict outside ethnolinguistic boundaries predominated (Ache, Arawete, Wari’) versus those with considerable levels of both internal and external conflict (Ayoreo, Hiwi, Kayapo).

Sex-specific counts of violent deaths allow calculation of the percent of males versus females that died violent deaths. An average of 69% of all violent deaths were males and 31% females. The percentage of male versus female violent death varies little across societies (standard deviation=8%). This result suggests that the opportunity for a selective pressure of violence is slightly more than twice as strong on males as it is on females.

3.2. Event-level body counts

Fig. 1 and Table 2 give event-level body counts at 3 scales of analysis (within village, internal war, and external war). Internal warfare events within ethnolinguistic boundaries dominate the database (55% of death events) with the remaining death events split between within-village homicides and external warfare events. Median body count is 1 death for within-village homicides and 2 deaths for both internal and external warfare events, with mean body counts higher for external warfare. One event of an estimated 300 deaths occurred in an external raid by the Mbaya in 1763 that destroyed another tribe (Muriel, 1918). Attackers were rarely killed in our sample; only 5 death events (out of 238 total or 2%) involved a

death of an aggressor. Chagnon (1968) notes that few Yanomamo attackers were killed or injured while raiding, and Beckerman et al. (2009) reported no reports of deaths or serious injuries in a large sample of Waorani raids.

To test for differences in the number of individuals killed across scales of analysis, a model with number of victims as the dependent variable and scale as the independent variable was estimated (with a Poisson link). The reference scale was within-village homicides; both internal and external warfare contrasts were statistically significant indicating that external warfare had the highest body count, followed by internal warfare, and then within-village homicides with the lowest (Fig. 1, Tables 2 and 3). Results were not altered when the outlying value of 300 victims was removed (237 observations; $z = 2.62, p = .009; z = 4.39 p < .0001$). A comparison between only internal and external warfare yields a Poisson regression coefficient of 0.7, which indicates the increase in the log of expected counts of external over internal warfare deaths per raid.

In order of importance, the tallied motives for killings (including multiple responses) were revenge for previous killings or other wrong-doings like adultery or sorcery ($n = 63$ or 70% of responses), jealousy over women ($n = 16$ or 18% of responses), gain of captive women and children ($n = 6$ or 7% of responses), fear or deterrence of an impending attack ($n = 3$ or 3% of responses), and lastly the theft of material goods ($n = 2$ or 2% of responses). Other reported motives were rather idiosyncratic (e.g., duels as a result of gossip, insults, stone throwing, provocations, garden theft, and boastful attitude of leaders) and were not included in these counts.

Captives of women and some children are more often taken on external raids (54% of raids) than on internal raids (26%). However, on those raids where women are taken, about twice as many are captured on average during internal raids (2.2) than in external raids (1.1), perhaps because longer distances must be travelled. This pattern leads to internal and external raids having the same overall average of women captured per raid (0.59). Unfortunately, ethnographic accounts rarely mention the actual number of men on raiding

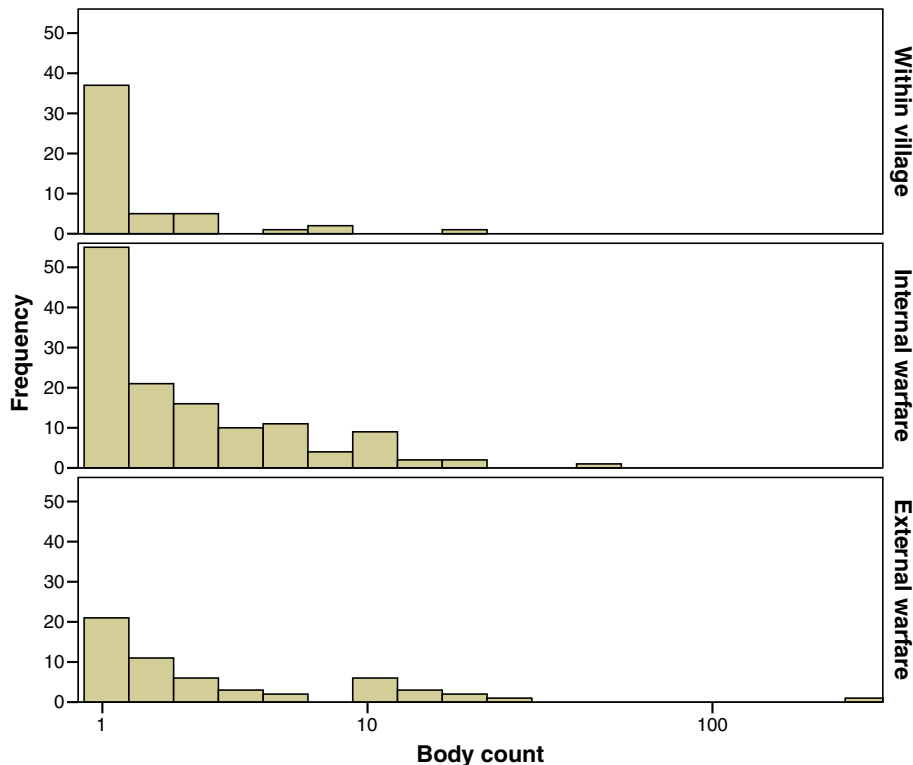


Fig. 1. Frequency distribution of body counts for different scales of conflict (within community versus internal war between communities in the same ethnolinguistic group versus external war between ethnolinguistic groups). Note the log scale on x-axis.

Table 2
Summary statistics for event-level body counts.

Level of events	N events	Total body count	Median body count	Mean body count	N raids with captives	Fraction raids that take captives	Total women captured	Women captured per raid	N treachery	Fraction treacherous
Within village	51	100	1	2.0	0		0		0	
Internal warfare	131	486	2	3.7	34	0.26	76	0.58	19	0.15
External warfare	56	559	2	10.0	30	0.54	33	0.59	2	0.04
SUM	238	1145			64		109		21	

Scale of conflict is defined as within community versus internal war between communities in the same ethnolinguistic group versus external war between ethnolinguistic groups. Only indigenous-on-indigenous killings are included in these results.

parties but a rough estimate is probably around 10–15 but with a skewed distribution that may occasionally reach into the hundreds.

3.3. Sequence of death events

Body counts of death events linked in sequences were collected whenever ethnographic information indicated that a revenge killing was a direct result of a previous killing ($n = 30$ sequences, 7 of which have body counts for counter-revenge attacks). To test for differences in the number of individuals killed across sequences of death events, a model with number of victims as the dependent variable and sequence as the independent variable was estimated. The main effect of sequence was positive, but only marginally significant (67 observations; $z = 1.69$, $p = .09$; the outlying value of victim count was not included in these analyses because it was not part of a sequence). Because there are only a small number of observations of sequences within villages, the observations within villages and from internal warfare were combined. This scale variable, along with its interaction with sequence, was added to the previous model. The main effect of sequence was not statistically significant ($z = .67$, $p = .51$), indicating that for internal warfare, victim count was unrelated to sequence, while the interaction between sequence and scale was marginally significant ($z = 1.91$, $p = .056$), indicating that the relation between sequence and victim count was more positive in external warfare. Finally, when the scale was recoded so that external warfare was the reference group, the main effect of sequence was statistically significant ($z = 2.50$, $p = .01$), indicating that, for external warfare, victim count increased with sequence.

3.4. Treachery

Treachery, such as hosting a malicious feast or feigning friendship in some manner to entice victims, is used more in internal warfare (19 treacherous death events or 15% of internal warfare attacks versus only 2 treacherous death events or 4% for external raids). To test for differences in body counts as a function of the use of treachery by the perpetrating group, a model with number of victims as the dependent variable and treachery as the independent variable was estimated.

The effect of treachery was statistically significant (238 observations; $z = 3.98$, $p < .0001$), despite the outlying value of victim count belonging to the no treachery category. When scale of analysis was added to this model, the effect of treachery increases in size (238 observations; $z = 4.31$, $p < .0001$). A comparison between treachery and other body counts yields a Poisson regression coefficient of 0.53, which indicates the increase in the log of expected counts of treacherous over non-treacherous death events. Table 3 summarizes the results from the event-level body count analyses.

4. Discussion

The compilation of 11 anthropological studies reporting cause of death in traditional lowland South American societies shows that violence led to about 30% of all deaths of which about 70% were males. These results are similar to mean values found in global surveys of farmer-foragers (Keeley, 1996; Bowles, 2009; Pinker, 2011). Cause-of-death studies are mixed in terms of the seriousness of internal versus external warfare. Event-level analyses suggest that external warfare events have higher body counts per raid, although internal raids are more than twice as frequent in our sample. Raids are more deadly when treachery is used, which is primarily an internal warfare strategy. External revenge raids kill more people on average than the original grievance, indicating a tendency towards escalation in violence and increasingly vicious cycles of revenge killings between ethnolinguistic groups. Although over half of all external raids take captives in our sample (over twice as frequently as internal raids), there are similar numbers of women taken on average per raid. In sum, internal war is more frequent and treacherous, while external war has more vicious revenge cycles and higher body counts, perhaps consistent with the parochial altruism model.

The applicability of the chimpanzee model appears to fit Amazonian warfare up to a point in that violence is often ongoing between groups, mostly low cost for attackers during any particular event, and includes some benefits in terms of access to captured females and goods and potentially to more territory. However, there appear to be several qualitative differences in tribal warfare. In particular, strong motivations for humans to seek revenge, which in

Table 3
Summary of results from the event-level body count analyses and their support for 2 models of warfare.

Death event results	N	z	p-value	Poisson Regression coefficient	Standard error	Supports chimpanzee model	Supports parochial altruism
External>Internal	238	4.12	<0.0001	0.72	0.18		yes
External>Within-village	238	4.55	<0.0001	0.89	0.20		yes
Internal>Within-village	238	1.72	0.09	0.23	0.13		yes
Treachery>Non-treachery	238	4.31	<0.0001	0.59	0.14		yes
Revenge>Original (External warfare)	64	2.50	0.01	0.68	0.27		yes
Revenge primary motivator	(70% of raids cite revenge as motive)						yes
Low cost for attackers	(attackers suffered deaths in 5 of 238 events or 2%)					yes	
Fitness benefits	(women and children captives; some goods)						yes
Fitness benefits	(disintegration/weakening of enemy groups)					yes	yes
Male coalitions						yes	yes
Group territoriality						yes	yes

the lowland South American case makes attacks increasingly costly, appears to represent a novel psychological trait in humans designed to deal with continual warfare by demonstrating resolve of individuals and the group to not be weak and intimidated by enemies. Not seeking revenge is an open admission to weakness and emboldens the enemy to further attacks and insults with impunity. Treachery also appears to represent a derived trait in humans that requires considerable in-group cooperation that is designed for between-group competition. The use of treachery, if convincing and successful, is an extreme example of a low cost attack by aggressors, consistent with the chimpanzee model, but involves sophisticated levels of within-group cooperation and enticement of between-group cooperation only possible in human societies, and of course opens up perpetrators to revenge raids in the future. Humans are also unique in demonstrating a multi-tiered social structure where marriage exchange, trade, and communication (language) serve to tie together multiple residential communities (Lévi-Strauss, 1949; Rodseth, Wrangham, Harrigan, & Smuts, 1991; Chapais, 2008; Hill, Walker, Bozicevic, Eder, et al., 2011). These mechanisms create meta-groups that ratchet up the scale of both cooperation and competition in warfare by uniting multiple families, lineages, villages, and even chiefdoms against other alliances often pitted against one another in cycles of ongoing violence motivated by revenge (Beckerman & Valentine, 2008; Boehm, 2011).

Multilevel selection is more salient when there is more genetic variance between groups and when these groups are in direct competition with one another, allowing the benefits of being in an altruistic group to outweigh within-group costs of altruistic behavior (Price, 1970; Frank, 1998; Henrich, 2004). Levels of genetic differentiation among Amazonian societies are some of the highest in the world with autosomal F_{ST} values averaging around 15%, over twice the world average (Wang, Lewis, Jakobsson, Ramachandran, et al., 2007; Lewis, 2010). Genetic heterozygosities within Amazonian societies average around 0.57, compared to world averages of 0.69 (Wang et al., 2007; Callegari-Jacques, Tarazona-Santos, Gilman, Herrera, et al., 2011). These patterns follow from the relatively small and isolated nature of many Amazonian societies promoting genetic drift, along with assortative fissioning, and in being one of the world's regions farthest in migrational distance from the East African homeland of modern humans. Migration between groups via marriage exchange erodes genetic differentiation, but if exchange occurs between friendly alliances then these entities are less likely to raid one another and more likely to cooperate in raids against common enemies. Therefore, the boundary where marriage-exchange networks end and open hostilities begin is the primary candidate for genetic group selection, because genetic differentiation and the force of between-group selection are expected to be the highest at this interface. While between-group competition may not consistently lead to direct extermination, some groups often become weakened, forced to merge with other groups, and suffer fitness depression.

Reproductive leveling also promotes multilevel selection by disseminating fitness benefits more widely amongst in-group members (Bowles, 2006), although leveling mechanisms are arguably best considered a consequence and not a cause of prosociality (Boyd, 2006). Reproductive leveling may be a particularly important component of multilevel selection in Amazonian societies because a lack of important heritable resources, like land and livestock (Gurven, Borgerhoff Mulder, Hooper, Kaplan, et al., 2010), leads to low levels of polygyny. Partible paternity, the conception belief that multiple men can be co-genitors of a single child, is also common in Amazonia (Beckerman & Valentine, 2002; Walker, Flinn, & Hill, 2010) and may represent another form of reproductive leveling. Extensive warfare, reproductive leveling, and high genetic differentiation are all potentially important factors for promoting multilevel selection (Bowles & Gintis, 2011). The current study cannot, however, determine whether selection has favored similar behaviors in groups

of humans around the world or whether special socio-ecological conditions have been particularly favorable towards promoting predispositions for between-group conflict in Amazonia.

Analogous to genetic multilevel selection is cultural group selection (Boyd & Richerson, 1985) that may prevail if cultural differentiation among groups is substantial and between-group competition is intense (Soltis, Boyd, & Richerson, 1995). The taking of captives, often an important aspect of much tribal and chiefly warfare, acts to erode genetic differentiation. However, this may not be true for cultural differentiation if captive wives and children quickly acculturate into new lifestyles of their captors, as appears to generally be the case (Chagnon, 1968; Stuart, 1980) via conformist-biased transmission (Henrich & Boyd, 1998). An unanswered question for Amazonia is the degree of cultural differentiation ("cultural F_{ST} values", Bell, Richerson, & McElreath, 2009) because data for cultural traits at multiple scales of social structure (e.g., individuals within villages within ethnolinguistic groups) are lacking. It does seem reasonable to assume that ethnolinguistic boundaries show the most between group cultural variation with boundaries defined by shared language, norms, and institutions. That said, detailed economic studies have found considerable variation between communities within ethnolinguistic boundaries in Amazonia and elsewhere (Henrich, Boyd, Bowles, Gintis, et al., 2005; Lamba & Mace, 2011; Apicella, Marlowe, Fowler, & Christakis, 2012). Future work is needed to examine whether behavioral and psychological adaptations related to warfare are truly best explained at the cultural or genetic group level or are more parsimoniously understood at the individual level.

In sum, we have documented what appears to be the potential for strong competitive selection of warfare across lowland South America with violent conflict common both within and between ethnolinguistic groups. Warfare dwarfs violence occurring within villages and therefore points to the importance of between-group competition that may help drive parochial altruism. Alternative explanations for widespread cooperation in warfare, such as mutualism, reciprocity, and direct individual benefits, do not seem attractive because direct per-capita benefits (e.g., captive women and limited stolen goods) appear small in comparison to the risk of reprisals. The two studies to quantify reproductive success of more renowned warriors have shown mixed results with both higher (Yanomamo: Chagnon, 1988) and lower (Woorani: Beckerman et al., 2009) fitness outcomes. Alternative explanations for cooperation also do not seem to fully explain the vicious cycles of revenge killings or the warfare-related cultural norms and institutions supporting group solidarity over individual interests such as widespread in-group cooperation, low levels of polygyny, costly initiation rites, training in warfare, men's houses, diverse rituals and ceremonies, and norm enforcement via gossip, fines, ostracism, and witchcraft accusations. For these reasons we favor the parochial altruism model and multilevel selection acting above the level of the individual to fully explain cooperation in lowland South American warfare.

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